Sensitivity analysis of climate change risk assessment

Study of parameters variation in hazard indicators

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Definitions

- Risk: potential for adverse consequences for human or ecological systems [...]

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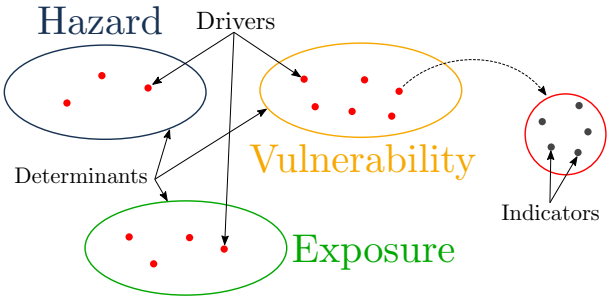
- Climate Change Risk Assessment (CCRA)



The problem

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- Analysis of the sensitivity of indicators to a change in value of their parameters, for drivers within the hazard determinant

Case study

- Torino Airport

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- Hazard drivers: heat wave, heavy precipitation

Climate datasets

- Climatological baseline: ERA5[1]
- Climate projections: NEX-GDDP-CMIP6[2]

[2]Hersbach et al., *ERA5 Hourly Data on Single Levels from 1940 to Present*.

[2]Thrasher, Wang, Michaelis, and Nemani, *NEX-GDDP-CMIP6*; Thrasher, Wang, Michaelis, Melton, et al., "NASA Global Daily Downscaled Projections, CMIP6".

ERA5

- Organisation: European Centre for Medium-Range Weather Forecasts
- Data type: reanalysis
- Spatial coverage: global
- Spatial resolution: 0.25° x 0.25°
- Temporal coverage: 1940-present
- Temporal resolution: hour

NEX-GDDP-CMIP6

- Organisation: NASA Earth Exchange
- Data type: statistically downscaled bias-corrected climate projections
- Spatial coverage: global
- Spatial resolution: 0.25° x 0.25°
- Temporal coverage: 1950-2100
- Temporal resolution: day
- Historical period 1950-2014, projection period 2015-2100
- Model: EC-Earth3
- Scenario: SSP1-2.6, SSP2-4.5, SSP5-8.5

Spatial domain

- Box of 3 x 3 grid points centred at the coordinates of the airport

Temporal domain

- Baseline period: 1994-2023
- Time horizons: 2021-2040, 2051-2070, 2081-2100

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   - maximum n-days precipitation amount (window size)
2. Fix exposure and vulnerability from literature
3. Evaluate risk following the guidelines

$$r = r(\mathcal{H}, \mathcal{E}, \mathcal{V}) = r(H, E, V) = \frac{w_H H + w_E E + w_V V}{w_H + w_E + w_V} = c_0 + c_1 H \qquad (1)$$

Preprocessing

1. Regrid ERA5
2. Aggregate ERA5 at daily frequency
3. Align NEX-GDDP-CMIP6 timestamps

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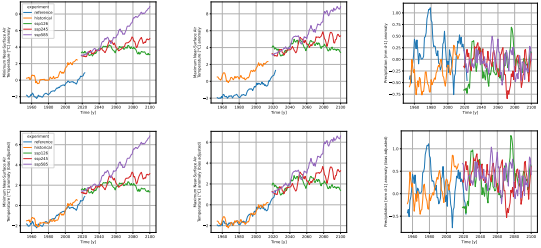
4. Bias adjustment



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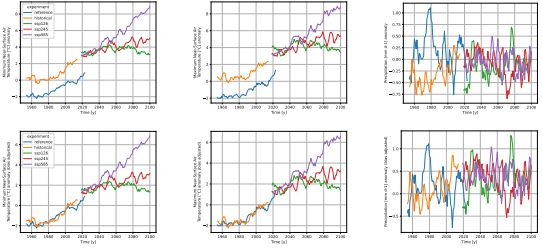
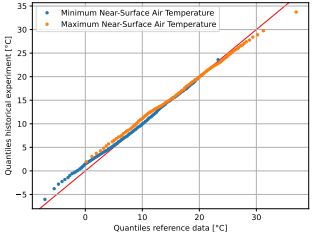
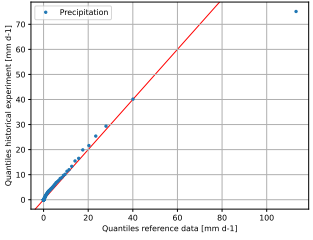
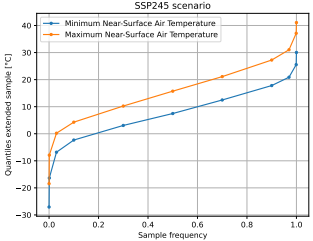


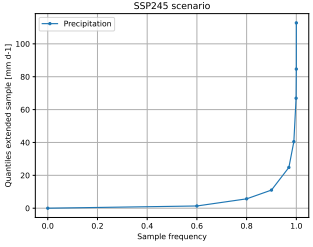




Evaluation of hazard indicators

1. Define intervals of parameter values





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1. Define intervals of parameter values
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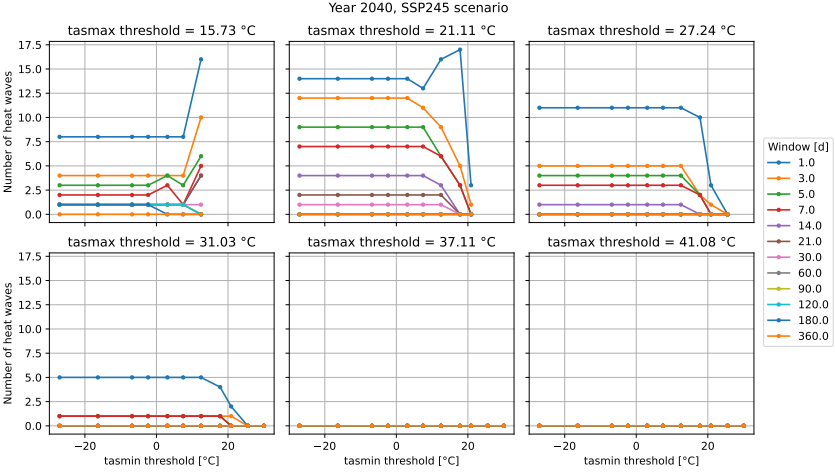
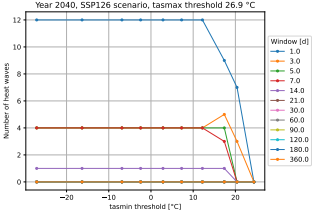
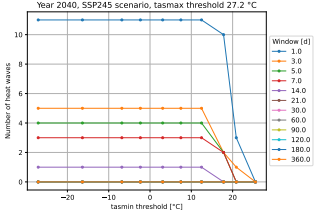
3. Temporal aggregation

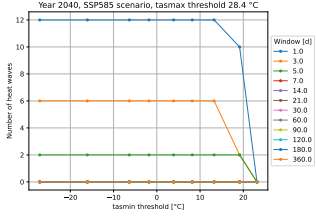
Heat wave frequency – Fixed scenario



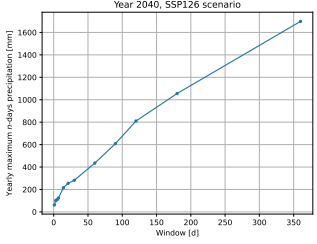
Heat wave frequency – Fixed tasmax threshold

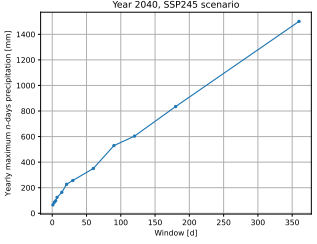


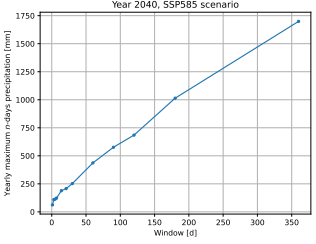




Maximum *n*-days precipitation amount







Next steps

- Extend analysis to other indicators for each hazard drivers
- Extend analysis to Bologna's and Ciampino's airports
- Sample intervals specifically for the location of interest
- Normalise indicators
- Evaluate risk with non-linear relations among hazard indicators and among determinants
- Evaluate uncertainty (multi-model ensemble)